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MEMORANDUM

To: Gene Kelly

From: Adrian Bradley

Date: January 19, 2000

RE: Vasquez Boulevard and I-70 Site – Statement of Work for Pilot Study of Physical and Chemical Characteristics

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This memorandum presents the Statement of Work (SOW) for the determination of physical characteristics of bulk soil for a pilot study at the Vasquez Boulevard and I-70 Site. The study will determine whether it is possible to distinguish between residential soils and suspected source area soils with respect to a series of physical and chemical attributes. This memo will ultimately be used by ISSI Consulting Group, Inc. (ISSI) for contractual purposes. Feel free to contact me at (303) 292-4142 ext. 256 if there are any issues or points that require additional discussion either on a design or contractual basis.

The particular requirements for this project are outlined below. All analyses will be performed according to the methods listed in the table below. Please provide minimum detection limits (MDL), proficiency test results, and/or similar quality control results for each of these methods. We will also need you to provide a Standard Operating Procedure (SOP) for the visual inspection methods that you will be using. Total costs for this project are not to exceed $14,000.

Bulk Soil Parameter	Method
Visual Inspection/Description (Qualitative Attributes)	Qualitative
Sand/Silt/Clay	ASTM D-2487
Particle Size Analysis	Gee & Bauder, 1986
Mineralogy of Sands, Silts, and Clays	XRD

ASTM – American Society for Testing and Materials
XRD– X-ray Diffraction

Visual Inspection/Description (Qualitative Attributes). Soils will be visually inspected by a qualified geologist. Qualities such as color, homogeneity and geologic composition will be noted. In addition, the presence of non-geologic materials will be recorded.

Sand/Silt/Clay and Particle Size Analysis. Soil particles smaller that 2000 μm are generally divided into three major size groups: sands, silts and clays. Size class for soils will be defined using a standardized system of classification developed by the American Society for Testing and Materials (ASTM). In addition, perlite particle size and distribution will also be examined.

Mineralogy of Sands, Silts, and Clays: This test employs use of XRD analysis to quantitatively classify soil into three standard soil classes: sands, silts, and clays. The sand and silt fractions will be analyzed using powder mounts, randomly oriented. Clay suspensions will be dried as thin films so that the plates are parallel to each other (preferred orientation). Specific mounting procedures are described in the mineralogy SOP (Appendix A).

All analyses must performed in accordance with the approved project plan (Project Plan for the Vasquez Boulevard & I-70 Pilot Scale Soil Characterization Study) and its associated standard operating procedures for bulk soil physical parameters analysis.

Deliverables

The Subcontractor will provide ISSI with the following deliverable package within 12 weeks of receipt of samples at the Subcontractor's laboratory: analytical report, quality control report and electronic deliverables.

The specific contents of each deliverable component are outlined below.

Deliverable Component	Constituents of the Deliverable Component
Analytical Report	The standard reporting format including: cross reference table identifying the lab and field IDs; case narrative summarizing the findings of the results; data entry logs; and results of each analysis.
QC Report	Summary of results of associated QC samples.
Electronic Files	Electronic form of data presented in the analytical report including elements described below.

Electronic Files

Electronic files should be presented in a spreadsheet format similar to the one provided by ISSI (Attachment 1). The electronic copy of the results should consist of 4 files, one for each of the parameters listed in the Bulk Soil Characterization Parameter Table. Each file should provide the same information as identified in Attachment 1.

PERIOD OF PERFORMANCE:

The period of performance shall be defined as February 1, 2000 to May 30, 2000.

ATTACHMENT 1

Attachment 1 Example of Database Format

ISSI Field Name	Field Name Definition	Data Type
Analysis Date Mineralogy	Date of analysis for Mineralogy	Bulk Soil Characterization
Analysis Date Particle Size	Date of analysis for Particle Size	Bulk Soil Characterization
Analysis Date Qualitative Attributes	Date of analysis for Qualitative Attributes	Bulk Soil Characterization
Analysis Date Sand/Silt/Clay	Date of analysis for Sand/Silt/Clay	Bulk Soil Characterization
Analysis Time Mineralogy	Time of analysis for Mineralogy	Bulk Soil Characterization
Analysis Time Particle Size	Time of analysis for Particle Size	Bulk Soil Characterization
Analysis Time Qualitative Attributes	Time of analysis for Qualitative Attributes	Bulk Soil Characterization
Analysis Time Sand/Silt/Clay	Time of analysis for Sand/Silt/Clay	Bulk Soil Characterization
Analyte Mineralogy	Analyte result for Mineralogy	Bulk Soil Characterization
Analyte Particle Size	Analyte result for Particle Size	Bulk Soil Characterization
Analyte Perlite	Analyte result for Perlite	Bulk Soil Characterization
Analyte Q Mineralogy	Analyte qualifier for Mineralogy	Bulk Soil Characterization
Analyte Q Particle Size	Analyte qualifier for Particle Size	Bulk Soil Characterization
Analyte Q Perlite	Analyte qualifier for Perlite	Bulk Soil Characterization
Analyte Q Qualitative Attributes	Analyte qualifier for Qualitative Attributes	Bulk Soil Characterization
Analyte Q Sand/Silt/Clay	Analyte qualifier for Sand/Silt/Clay	Bulk Soil Characterization
Analyte Qualitative Attributes	Analyte result for Qualitative Attributes	Bulk Soil Characterization
Analyte Sand/Silt/Clay	Analyte result for Sand/Silt/Clay	Bulk Soil Characterization
Analytical Method Mineralogy	Analytical Method for Mineralogy	Bulk Soil Characterization
Analytical Method Particle Size	Analytical Method for Particle Size	Bulk Soil Characterization
Analytical Method Perlite	Analytical Method for Perlite	Bulk Soil Characterization
Analytical Method Qualitative Attributes	Analytical Method for Qualitative Attributes	Bulk Soil Characterization
Analytical Method Sand/Silt/Clay	Analytical Method for Sand/Silt/Clay	Bulk Soil Characterization
Detection Limit Mineralogy	Method detection limit for Mineralogy	Bulk Soil Characterization
Detection Limit Particle Size	Method detection limit for Particle Size	Bulk Soil Characterization
Detection Limit Perlite	Method detection limit for Perlite	Bulk Soil Characterization
Detection Limit Qualitative Attributes	Method detection limit for Qualitative Attributes	Bulk Soil Characterization
Detection Limit Sand/Silt/Clay	Method detection limit for Sand/Silt/Clay	Bulk Soil Characterization
Field ID	Full Field ID	Bulk Soil Characterization
Lab ID Mineralogy	Laboratory Sample ID for Mineralogy analysis	Bulk Soil Characterization
Lab ID Particle Size	Laboratory Sample ID for Particle Size analysis	Bulk Soil Characterization
Lab ID Perlite	Laboratory Sample ID for Perlite analysis	Bulk Soil Characterization
Lab ID Qualitative Attributes	Laboratory Sample ID for Qualitative Attributes analysis	Bulk Soil Characterization
Lab ID Sand/Silt/Clay	Laboratory Sample ID for Sand/Silt/Clay analysis	Bulk Soil Characterization
Preparation Method No Mineralogy	Preparation Method Reference for Mineralogy	Bulk Soil Characterization
Preparation Method No Particle Size	Preparation Method Reference for Particle Size	Bulk Soil Characterization
Preparation Method No Perlite	Preparation Method Reference for Perlite	Bulk Soil Characterization
Preparation Method No Qualitative Attrib	Preparation Method Reference for Qualitative Attributes	Bulk Soil Characterization
Preparation Method No Sand/Silt/Clay	Preparation Method Reference for Sand/Silt/Clay	Bulk Soil Characterization
Units Mineralogy	Units of measure for Mineralogy	Bulk Soil Characterization
Units Particle Size	Units of measure for Particle Size	Bulk Soil Characterization
Units Perlite	Units of measure for Perlite	Bulk Soil Characterization
Units Qualitative Attributes	Units of measure for Qualitative Attributes	Bulk Soil Characterization
Units Sand/Silt/Clay	Units of measure for Sand/Silt/Clay	Bulk Soil Characterization
COC No	Chain-of-Custody Number	COC
Comp/Grab	Sample type: composite or grab sample	COC
Field ID	Full Field ID	COC
Sample Date	Date sampled in the field	COC
Sample Time	Time sampled in the field	COC
Field ID	Full Field ID	Field Collection
Old Field ID	North Denver Field ID	Field Collection
Sample Type	Distinguishes between field and QC samples (e.g. field, duplicate)	Field Collection